Occupational therapy for rheumatoid arthritis: A systematic review

Steultjens, E.M.J.; Dekker, J.; Bouter, L.M.; van Schaardenburg, D.; Van Kuyk, M.A.H.; van den Ende, C.H.M.

published in
Arthritis & Rheumatism
2002

DOI (link to publisher)
10.1002/art.10801

document version
Publisher's PDF, also known as Version of record

Arthritis & Rheumatism (Arthritis Care & Research)
Vol. 47, No. 6, December 15, 2002, pp 672–685
DOI 10.1002/art.10801

REVIEW

Occupational Therapy for Rheumatoid Arthritis: A Systematic Review

ESTHER M. J. STEULTJENS,[1] JOOST DEKKER,[2] LEX M. BOUTER,[2] DIRKJAN VAN SCHAARDENBURG,[3] MARIE-ANTOINETTE H. VAN KUYK,[4] AND CORNELIA H. M. VAN DEN ENDE[1]

Patients with rheumatoid arthritis (RA) show a reduction in physical capacities compared with healthy persons. Symptoms such as pain, fatigue, stiffness, and decreased muscle strength cause difficulties with daily activities such as grooming and dressing, cooking a meal, cleaning, shopping, work, and leisure activities. The physical, personal, familial, social, and vocational consequences of RA are extensive. Occupational therapy (OT) is concerned with facilitating people in performing their activities of daily living overcoming barriers by maintaining or improving abilities, or compensating for decreased ability in the performance of occupations (1). The most important interventions in OT are training of skills, counseling, education about joint protection, prescription of assistive devices, and the provision of splints (2). Advice/instruction in the use of assistive devices, training in self-care activities, and training in productivity activities are the 3 interventions for RA patients chosen most often by occupational therapists (3).

So far, one narrative review (4) discussed the effectiveness of splinting, joint protection, and provision of aids/equipment for several rheumatic diseases on the basis of the results of only a few studies on OT. However, evidence on the effects of OT on the functional performance and social participation of RA patients has not been reviewed systematically. Therefore, we conducted a systematic review of published studies evaluating occupational therapy for rheumatoid arthritis.

Supported by grant 99-2-102 from the Dutch League Against Rheumatism (National Reumafonds).
[1]Esther M. J. Steultjens, BScOT, MA, Cornelia H. M. van den Ende, PhD: Netherlands Institute for Health Services Research, Utrecht, The Netherlands; [2]Joost Dekker, PhD, Lex M. Bouter, PhD: VU University Medical Centre, Amsterdam, The Netherlands; [3]Dirkjan van Schaardenburg, MD, PhD: Van Breemen Institute, Amsterdam, The Netherlands; [4]Marie-Antoinette H. van Kuyk, MScOT: University Medical Center, Nijmegen, The Netherlands

Address correspondence to Esther M. J. Steultjens, BScOT, MA, Netherlands Institute for Health Services Research, PO Box 1568, 3500 BN Utrecht, The Netherlands. E-mail: e.steultjens@nivel.nl.

Submitted for publication July 4, 2001; accepted in revised form April 23, 2002.

Methods

Search strategy. We conducted an extensive search in the following databases: Medline (1966 to January 2001), Cinahl (1982 to March 2001), Embase (1988 to April 2000), Scisearch (1974 to April 2000), Cochrane Controlled Trials Register, the databases of the libraries of medical and rehabilitation literature of 2 Dutch institutes (Dutch National Institute Allied Health Professions, Netherlands Institute for Health Services Research) (May 2000), the database of the Rehabilitation and Related Therapies Field of the Cochrane Collaboration (August 2000), and the specialized trials register of the Cochrane Musculoskeletal Group (August 2000). Our broad computerized search strategy was built upon the following components: a) the search strategy for randomized controlled trials (RCTs) and controlled clinical trials (CCTs) recommended by the Cochrane Musculoskeletal Group (5), b) a search strategy for other designs (ODs) using the keywords "epidemiologic studies," "evaluation studies," "program evaluation," "questionnaires," "patient series," "case series," "program,*" "experiment,*" "observation,*" "method,*" and "effect,*" c) a search strategy for the identification of studies involving RA patients using the terms "arthritis" and "rheumatoid arthritis," and d) a search strategy for the identification of studies involving occupational therapy interventions using the terms "occupational therapy," "training," "education," "splints," "assistive devices," "counseling," "joint protection," "dexterity," "activities of daily living," and "self-care."

The search strategy was formulated in WinSpirs (Medline, Cinahl) and was adapted by an experienced medical librarian to make it applicable to the other databases. The same databases were searched to identify reviews about the effectiveness of OT, in order to find more studies. Additionally, the reference lists of all identified studies and reviews were scanned. Finally, the corresponding authors of reports eligible for inclusion in this review were contacted by mail and were asked to provide any additional published studies relevant to this systematic review.

Selection for inclusion. Because occupational therapy is a relatively young profession, and because literature

about the efficacy of OT was expected to be sparse, study designs other than controlled clinical trials were also included in this systematic review. As will be explained below, uncontrolled studies could only restrictedly contribute to the best evidence syntheses (indicative findings; see Data Analysis). Studies with the following designs were included: 1) RTCs. Experiments in which investigators randomly allocate eligible subjects into treatment and control groups. Crossover trials were considered as RCTs, according to the Cochrane Collaboration guidelines (6); 2) CCTs. Experiments in which eligible subjects are allocated in a nonrandomized manner to the treatment and the control groups; 3) ODs. Patient series, pre–post studies, as well as studies comparing interventions on different hands of the same person. Only full-length articles or full written reports were considered for inclusion in the review.

Studies of patients with a diagnosis of rheumatoid arthritis were included. Occupational therapy interventions were either regarded as comprehensive OTs (combination of all interventions) or were classified into 6 specific intervention categories as follows: 1) training of motor function, 2) training of skills, 3) instruction on joint protection, 4) counseling, 5) advice and instruction in using assistive devices, and 6) provision of splints. Studies focusing on a contrast between the experimental and control groups consisting of a multidisciplinary intervention (with OT as part of it) were excluded.

The outcome measures pain, fatigue, functional ability (including dexterity), and social participation were included. Occupational therapy also focuses on measures considered to be mediators of a favorable outcome, such as knowledge about disease management, compliance, self-efficacy, grip strength, and range of motion. These process measures are considered to be indicators of a successful treatment and are therefore also covered in this review. As will be explained below, process measures could only restrictedly contribute to the best evidence syntheses (indicative findings; see Data Analysis). Studies with one or more of the specified outcome or process measures were included.

Procedure for inclusion. The procedure for inclusion of the studies was based on the recommendations described by Van Tulder et al (7). The first selection, based on titles and abstracts, was independently performed by 2 reviewers (EMJS and CHME), who considered the criteria for type of study, type of participants, and type of outcome measures. This first selection resulted in inclusion of the study, exclusion of the study, or was considered indecisive. The second step for inclusion was done independently by 2 reviewers (EMJS and CHME), using full reports of all included and indecisive studies and considering all the criteria described above. Disagreements regarding inclusion status were resolved by discussion. If no consensus was met, a third reviewer (MAHK) decided. Finally, a group of 4 occupational therapists and reviewer CHME assessed the criteria for type of intervention and, if appropriate, classified the type of intervention into comprehensive OT or one of the 6 different interventions. Consensus was reached by discussion.

Methodologic quality. The methodologic quality of RCTs and CCTs was rated using a list recommended by Van Tulder et al (7). The list, containing specified criteria proposed by Jadad et al (8) and Verhagen et al (9), consists of 11 criteria for internal validity, 6 descriptive criteria, and 2 statistical criteria (Appendix 1). One modification was made in the specification of the eligibility criterion: the condition of interest (impairment or disability that indicated referral to OT) was added as an eligibility criterion, as proposed by Wells et al (10). All criteria were scored as yes, no, or unclear. Studies were considered to be of high quality if at least 6 criteria for internal validity, 3 descriptive criteria, and 1 statistical criterion were scored positively.

The methodologic quality of the other designs has been rated using an adapted version of the list described by Van Tulder et al (Appendix 1). Some items (concerning randomization, similarity of patient groups, blinding of care provider, blinding of patient) were considered inapplicable to ODs and were removed from the list. Some items were reformulated to make them applicable to one patient group (e.g., the item "Were co-interventions avoided or comparable?" was reformulated into "Were co-interventions avoided?") or to make the item applicable to the design of the study (e.g., the item "Was the outcome assessor blinded to the intervention" was reformulated into "Was the care provider not involved in the outcome assessment?"). The final list of criteria used in ODs consists of 7 criteria for internal validity, 4 descriptive criteria, and 2 statistical criteria (Appendix 1). All criteria were scored as yes, no, or unclear. Studies were considered to be of sufficient quality if at least 4 of 7 criteria for internal validity, 2 descriptive criteria, and 1 statistical criterion were scored positively.

The methodologic quality of the included trials was independently assessed by 2 reviewers (EMJS, MAHK). Disagreements were resolved by discussion. If no consensus was met, a third reviewer (CHME) decided.

Data analysis. A predefined data extraction form, with study characteristics, patient characteristics, and baseline, posttest, and followup data of outcome and process measures, was used. For continuous variables, the standardized mean difference (Hedges' g) was calculated, if possible (11). For dichotomous variables, odds ratios with corresponding 95% confidence intervals were computed.

Analysis of the results was performed separately for each intervention category. For crossover trials without a washout period between interventions, data were not further analyzed. If studies compared the effect of 3 or more intervention groups with each other, 2 reviewers (EMJS, CHME) decided by consensus which 2 groups had the largest contrast, making comparison between 2 groups possible. A contrast between the OT intervention group and a nontreated control group was preferred. If 2 interventions were compared, the predominant contrast was the OT provided.

In advance, we expected to find too much diversity among the studies with regard to patients (severity of the disease), interventions (duration, frequency, and setting),

Table 1. Best evidence synthesis*

Strong evidence	Provided by consistent, statistically significant findings in outcome measures in at least two high quality RCTs†
Moderate evidence	Provided by consistent, statistically significant findings in outcome measures in at least one high quality RCT and at least one low quality RCT or high quality CCT†
Limited evidence	Provided by statistically significant findings in outcome measures in at least one high quality RCT†, or provided by consistent, statistically significant findings in outcome measures in at least two high quality CCTs† (in the absence of high quality RCTs)
Indicative findings	Provided by statistically significant findings in outcome and/or process measures in at least one high quality CCT or one low quality RCT† (in the absence of high quality RCTs), or provided by consistent, statistically significant findings in outcome and/or process measures in at least two ODs with sufficient quality (in absence of RCTs and CCTs)†
No evidence	In cases of results of eligible studies that do not meet the criteria for one of the above-stated levels of evidence, or in case of conflicting results among RCTs and CCTs, or in case of no eligible studies

* RTCs = randomized controlled trials; CCTs = controlled clinical trials; ODs = other designs.
† If the proportion of studies that show evidence is <50% of the total number of studies within the same category of methodological quality and study design (RCTs, CCTs or ODs), we state no evidence.

and outcome measures (diversity, presentation of results) to make quantitative analysis (meta-analysis) appropriate. Therefore, we formulated a best evidence synthesis by attributing various levels of evidence to the effectiveness of OT, taking into account the design of the studies, the methodologic quality, the type of outcome measures, and the statistical significance of findings. The best evidence synthesis (Table 1) was based upon the one proposed by Van Tulder et al (12) and was adapted for the purpose of this review.

Only results of studies contributing to the outcome of the best evidence synthesis (e.g., RCTs with a high methodologic quality, low quality RCTs with significant findings, high quality CCTs with significant findings, and high quality ODs with significant findings) are presented. Characteristics and comprehensive results of all included studies on outcome and process measures are on request available from the corresponding author.

Three sensitivity analyses were performed: 1) excluding low quality studies, 2) considering studies to be of high quality if 4 or more criteria of internal validity were met, and 3) excluding studies that did not use the American College of Rheumatology criteria for the diagnosis of RA (13).

Results

Selection of studies. The search strategy resulted in a list of 2,137 citations. After selection by title and abstract, 149 full articles were obtained. Fifty-seven publications concerned the effectiveness of occupational therapy for RA. Of these, 42 articles, presenting 37 studies (15 RCTs, 6 CCTs, 16 ODs), fulfilled all inclusion criteria. Data from 4 studies were presented in more than one article (14–23). One publication (24) presented 2 studies. Fifteen studies (25–39) were excluded for the following reasons: because treatment contrast was a multidisciplinary intervention, because patients other than those with rheumatic diseases participated in the study, or because outcome measures were beyond the scope of our review (Appendix 2).

Methodologic quality. The methodologic quality of 21 RCTs/CCTs and in 16 ODs was assessed (Table 2). Five RCTs (40–44) had high methodologic quality, and all CCTs had low quality. In particular, the following criteria were fulfilled in fewer than one-third of the RCTs/CCTs: adequate allocation concealment, blinded care provider, blinding of patients, information on co-interventions, blinded outcome assessor, intention to treat analysis, and long-term followup. Given the methodologic constraints of other designs, 9 ODs (45–53) had sufficient methodologic quality. The following criteria were fulfilled in one-third or fewer of the ODs: outcome assessor not involved in treatment and long-term followup.

Outcome of interventions. *Comprehensive occupational therapy.* Four studies on the effectiveness of comprehensive OT were identified (Table 3): 3 RCTs (14,41,54) and one OD (55). One of the RCTs (41) had high methodologic quality. The results on outcome measures are shown in Table 4. In the high quality RCT, Helewa et al (41) reported a significant positive effect of comprehensive OT on functional ability. The process measure "knowledge" was assessed in one study (54), in which no difference in gain in knowledge between the intervention and the control groups was reported. Thus, on the basis of one RCT (41), there is limited evidence for the effectiveness of comprehensive OT on functional ability (Table 5).

Training of motor functions. Seven studies (6 RCTs/CCTs [16,42,56–59] and one OD [60]) focused on the intervention "training of motor function" (Table 3). Interventions varied from group instruction on expressive dance (16), use of a continuous passive motion machine after arthroplasty (58), to hand exercises (42,56,57,59,60). The

Table 2. Characteristics and quality of randomized clinical trials, controlled clinical trials, and other designs*

Authors (ref.)	Internal validity	Descriptive	Statistical	Methodologic quality
Randomized clinical trials				
Kraaimaat et al (14)	b1, g, j, l, n,	c, d, m1, m2	o, q	low
van Deusen and Harlowe (16)	b1, l, n	m1, m2	o	low
Stern et al (21)	b1, g, j	a, c, d, k, m1	o, q	low
Neuberger et al pilot (24)	b1, j	d, m1	o	low
Hammond et al (40)	b1, g, i, j, n, p	a, c, d, k, m1	o, q	high
Helewa et al (41)	b1, e, f, i, j, l, n, p	a, c, d, m1	o, q	high
Hoenig et al (42)	b1, e, f, g, i, j, n	c, d, k, m1	o	high
Ter Schegget and Knipping (43)	b1, g, j, l, n, p	d, k, m1	o, q	high
Tijhuis et al (44)	b1, g, j, l, n, p	a, c, d, k, m1	o, q	high
Mowat et al (54)	b1, f, i, j, l, n,	a, c, d, m1, m2		low
Brighton et al (56)	b1, g, i, n	d, m1	o	Low
Wagoner and le Lieuvre (59)	b1, g, j, l, n	d, m1	o	low
Anderson and Maas (62)	b1, f, g, n	c, d, m1	o, q	Low
Callinan and Mathiowetz (63)	b1, g, j, l, n,	a, d, k, m1	o,	low
Palchik et al (65)	b1, l	a, k, m1	o	low
Controlled clinical trials				
Furst et al (19)	j, n, p	a, c, d, m1, m2	o, q	low
Neuberger et al (24) follow-up	j	c, d, m1	o, q	low
Dellhag et al (57)	f, j, n	c, d, m1		low
Ring et al (58)	i, l	d, k, m1	o, q	low
Hass et al (61)	j	d, m2	o	low
Feinberg (64)	h, j, l, n	a, c, d, m1	o, q	low
Other designs				
Barry et al (45)	g, i, l, n	m1, m2	o, q	sufficient
Cartlidge et al (46)	f, j, l, n, p	a, d, m1	o	sufficient
Hammond (47)	g, i, j, l, n	a, d, m1	o, q	sufficient
Hammond and Lincoln (48)	g, j, l, n	a, d, m1	o, q	sufficient
McKnight and Schamburg (49)	f, j, l, n	a, d, k, m1	o	sufficient
Nordenskiöld (50)	f, g, j, l, n, p	d, m1	o, q	sufficient
Nordenskiöld (51)	f, g, j, n	d, m1	o	sufficient
Pagnotta et al (52)	f, g, j, l, n, p	a, d, k, m1	o, q	sufficient
Rennie (53)	g, j, l, n, p	d, m1	o, q	sufficient
McAlphine et al (55)	j, n	m1	o, q	low
Schaufler et al (60)	j, n, p	d, m1	o	low
Agnew and Maas (66)	l, p	k, m2	o, q	low
Feinberg and Brandt (67)	j	a, d, k, m2	o	low
Malcus et al (68)	f, j, l	a, d, k, m1	o	low
McKnight and Kwoh (69)	f, j, n	a, d, k, m1	o, q	low
Spoorenberg et al (70)	j	a, d, k	o, q	low

* See Supplement to Appendix 1 for definitions.
Only the fulfilled criteria are reported. For cutoff point low/high quality see section on methodologic quality.

interventions on hand exercises varied widely with regard to type of exercises, type of device used, type of setting for therapy (at home without supervision or at an OT department with supervision), and duration of the intervention. One study (42) had high methodologic quality.

The results on outcome measures are shown in Table 4. The outcome measures "pain" and "functional ability" were assessed in two (42,57) and three (42,57,60) studies, respectively. In the RCT with high methodologic quality (42), no significant differences between groups with regard to pain and functional ability after training of hand function were reported.

All studies measured 1 or 2 of the following process measures: compliance (16,59), grip strength (42,56–58,60), and range of motion (16,42,56–58,60). In the high quality RCT (42), no significant differences in grip strength between groups were found, whereas in the low quality RCT (56), significant changes in grip strength after training of hand function were reported. Thus, there is no evidence for the effectiveness of training of motor function on the outcome and process measures (Table 5).

Instruction on joint protection and energy conservation. Four RCTs/CCTs (19,24,40) and four ODs (45–48) (Table 3) were identified for the intervention "instruction on joint protection and energy conservation." One of the RCTs (40) had high methodological quality.

The results on outcome measures are shown in Table 4. Seven studies (19,24,40,45,47,48) assessed functional ability. Hammond et al (40) reported significant improvement in functional ability. This finding was supported by Neuberger et al (24), who reported significant improvement in their CCT. Four studies (19,24,40,48) measured pain. Hammond et al (40) reported no significant differences between groups.

Table 3. Characteristics of included RCTs/CCTs

Authors (ref.)	No. of participants	Methods	Inclusion criteria/setting	Intervention	Frequency and duration of intervention	Outcome measure
All OT interventions combined						
Kraaimaat et al (14)	77	RCT	RA†, class I, II, III‡, min age 20, duration of illness ≥1 yr. Outpatients	I: group OT treatment§ R: waiting list/no treatment	2 hours for 10 weeks	Pain: IRGL Functional ability: IRGL Anxiety, depression: IRGL Knowledge: questionnaire
Helewa et al (41)	105	RCT	RA†, limitation in physical function, clinical stable, stable drug therapy. In community	I: individual OT treatment§ R: no treatment	6 weeks	Pain: VAS Functional ability: questionnaire, HAQ Depression: Beck scale
Mowat et al (54)	137	RCT	Definite RA, treated at RA-unit for a minimum of 14 days. Outpatients	I: individual OT followup§ at home R1: follow-up by general practicioner R2: follow-up by routine hospital care	every 3 months or more if needed	Functional ability: ADL-list Participation: ADL-list social scale Knowledge: questionnaire
Training of motor function						
van Deusen and Harlowe (16)	46	RCT	RA, ambulatory, recommendation for home rest and exercise. Outpatients	I: group instruction on expressive dance and discussion§ R: traditional exercise and rest	90 minutes for 8 weeks	Compliance: exercise-rest rating scales Range of motion: goniometer
Hoenig et al (42)	57	RCT	RA†, Class II and III‡ In community	I1: ROM tendon gliding exercises I2: resistive theraputty 85 I3: I1 and I2 R: no treatment	twice daily 10–20 minutes for 3 months	Pain: articular index Dexterity: 9 hole peg test Grip strength: aneroid manometer Range of motion: MCP-PIP
Brighton et al (56)	44	RCT	RA, sero-positive rheumatoid factor >1 yr, erosion in the MCP and/or PIP joints of the hand In community	I: exercises of the hand at home plus reinforcement by therapist R: no exercise	on daily basis for 4 years	Grip strength: sphygmomanometer Range of motion: goniometer
Dellhag et al (57)	52	CCT	RA, <70 yrs, disease duration >6–<10 yrs Class I, II‡, decreased ROM and/or grip strength, Outpatients	I1: wax bath and hand exercise I2: wax bath only I3: exercise only R: no treatment	3× week, for 4 weeks	Pain: VAS Dexterity: Sollermantest Grip strength: Grippit Range of motion: goniometer
Ring et al (58)	24	CCT	RA, MCP silicone rubber interposition arthroplasty for all fingers recommended Outpatients	I: the continuous passive motion machine R: 10 repetitions extension/flexion	I: as tolerated for 6 weeks R: Every 2 hours	Grip strength: dynamometer Range of motion: goniometer
Wagoner and leLieuvre (59)	12	RCT	RA, with hand involvement Outpatients	I: 10 squeezes Hand Helper both hand visual display R: same as I: without visual display	two/three times a day for 6 weeks	Compliance: percentage exercises Grip strength: sphygmomanometer Range of motion: goniometer

(continued)

Table 3. Characteristics of included RCTs/CCTs *(Continued)*

Authors (ref.)	No. of participants	Methods	Inclusion criteria/setting	Intervention	Frequency and duration of intervention	Outcome measure
Instruction on joint protection						
Furst et al (19)	28	CCT	RA† >1 year, not receiving energy conservation training, no mobility limitations, ≥18 yrs In- and outpatients	I: group/individual OT education program using specific didactic format,§ R: individual routine OT treatment	I: 1.5 hour for 6 weeks R: 50-min/2 hrs, 1 to 3 times	Pain: VAS Fatigue: VAS Functional ability: HAQ Participation: PAIS Knowledge: questionnaire Grip strength: sphygmomanometer
Neuberger et al (24) pilot	45	RCT	RA, Outpatients	I: self instructional OT§ programme plus feedback R: no intervention	25 minutes, 4 sessions	Functional abilities: observation Knowledge: questionnaire
Neuberger et al (24) follow-up	98	CCT	RA, Outpatients	I1: self instructional OT§ programme I2: I1 + ROM exercise and JPP I3: I1+I2 + nurse/pt contact R: no intervention	30–45 minutes, 4 sessions	Pain: VAS Functional abilities: observation Participation: depression Knowledge: questionnaire
Hammond et al (40)	35	RCT	RA†, class III‡, wrist and hand involvement Outpatients	I: group OT education§ based on health belief model and self-efficacy theory R: no intervention	2 hours, 4 sessions	Pain: VAS, HAQ Functional abilities: JPBA, HAQ Knowledge: questionnaire Self-efficacy: Arthritis self-efficacy scale Grip strength: dynamometer Range of motion: HJAM
Advice/assistive devices						
Hass et al (61)	190	CCT	RA, In community	I: group OT sessions, improved user information and altered selection process§ R: routine for prescription devices	4 sessions	Pain: FSI (pain) Functional abilities: FSI Participation: SIP
Provision of splints						
Stern et al (21)	42	RCT, cross over trial	RA, class II, III‡, wrist involvement dominant hand Outpatients	I1: Alimed working splint, wash-out period of 1 week I2: Rolyan working splint I3: Futuro working splint	4 hours, 5–7 days	Pain: interview Dexterity: Jebsen Taylor test Grip strength: dynamometer
Tijhuis et al (44)	10	RCT, cross over trial	RA†, swollen/painful wrist of the dominant hand, Outpatients	I1: Thermolynn orthosis I2: Futuro orthosis	as much as possible, 2 weeks	Pain: VAS Grip strength: vigorimeter Range of motion: goniometer
Ter Schegget and Knipping (43)	18	RCT, cross over trial	Swanneck deformities Outpatients	I1: SRS othosis, I2: custom made orthosis	each day, 6 months	Pain: VAS Dexterity: questionnaire Grip strength: My gripper Range of motion: goniometer

(continued)

Table 3. Characteristics of included RCTs/CCTs *(Continued)*

Authors (ref.)	No. of participants	Methods	Inclusion criteria/setting	Intervention	Frequency and duration of intervention	Outcome measure
Anderson and Maas (62)	92	RCT	RA, Outpatients	I1: dorsal working splint I2: palmar splint I3: gauntlet splint I4: fabric ready made splint R: no splint	1 session	Grip strength: sphygmomanometer
Callinan and Mathiowetz (63)	45	RCT cross over trial	RA†, presence of hand pain/ morning stiffness, Outpatients	I1: soft resting splint, I2: hard resting splint R: no splint	28 nights	Pain: AIMS2 Functional abilities: AIMS2, compliance: diary Grip strength: dynamometer
Feinberg (64)	46	CCT	RA†, class I, II‡, Outpatients	I: resting splint extensive compliance§ R: resting splint	1 session	Pain: 5 pt. scale Compliance: dairy
Palchik et al (65)	7	RCT	Boutonierre deformity RA origin, passive correctable, loss of PIP extension <25°. Outpatients	I: gutter splint R: no intervention	24 hours for 6 weeks	Range of Motion: goniometer

* RCT = randomized clinical trial; CCT = controlled clinical trial; OD = other design; OT = Occupational therapy; RA = rheumatoid arthritis; I = Index group; R = reference group; ROM = range of motion; MCP = metacarpal phalangeal; PIP = proximal interphalangeal; ADL = activities of daily living; SRS = silver ring splint; VAS = visual analogue scale; HAQ = Health Assessment Questionnaire; IRGL = Impact of Rheumatic Diseases on Health and Lifestyle; PAIS = Psychosocial Adjustment to Illness scale; JPBA = Joint Protection Behavior Assessment; HJAM = Hand Joint Alignment and Motion scale; FSI = Functional Status Index; SIP = Sickness Impact Profile; AIMS2 = Arthritis Impact Measurement Scales 2.
† Criteria for definite or classical rheumatoid arthritis according to the American Rheumatism Association (ARA) (13).
‡ ARA functional classification.
§ Occupational therapy treatment—biomedical information, energy conservation, joint protection, use of devices and splints, exercise for hands.

Table 4. Results on pain and functional abilities per intervention category; studies contributing to the outcome of the best evidence synthesis*

First author (ref.)	Design	Methodologic quality†	Pain	Functional ability
			SMD (95% CI)	SMD (95% CI)
Comprehensive OT				
Kraaimaat (14)	RCT	0	−0.17 (−0.76, 0.41)	−0.26 (−0.84, 0.33)
Helewa (41)	RCT	1	ns	0.49 (0.10, 0.89)
Mowat (54)	RCT	0	not measured	ne
Training of motor function				
Hoenig (42)	RCT	1	ns	ns
Dellhag (57)	CCT	0	0.81 (0.10, 1.61)	ns
Instruction on joint protection				
Furst (19)	CCT	0	1.2 (0.20, 7.18)	0.17 (−0.68, 1.02)
Neuberger (24) pilot	RCT	0	not measured	0.65‡ (−0.03, 1.33)
Neuberger (24) follow up	CCT	0	0.31 (−0.49, 1.10)	1.45 (0.55, 2.34)
Hammond (40)	RCT	1	0.56 (−0.12, 1.24)	1.79 (0.98, 2.61)
Advice assistive devices				
Nordenskiöld (51)	OD	1	$P < 0.001$	not measured
Hass (61)	CCT	0	ne	ne
Provision of splints				
Stern (21)	RCT	0	ne	immediately, $P < 0.001$, 1 week, $P = 0.015$
Ter Schegget (43)	RCT	1	0.34 (−0.59, 1.27)	1.02 (−0.03, 2.01)
Tijhuis (44)	RCT	1	−0.44 (−1.33, 0.44)	not measured
Nordenskiöld (50)	OD	1	immediately, $P < 0.001$	not measured
Pagnotta (52)	OD	1	immediately, $P < 0.001$	$P < 0.01$
Callinan (63)	RCT	0	$P < 0.001$	not measured
Feinberg (64)	CCT	0	$P = 1.00$	not measured

* SMD = standardized mean difference; 95% CI = 95% confidence interval; OT = occupational therapy; RCT = randomized clinical trial; CCT = controlled clinical trial; OD = other design; ns = no significant differences between groups; ne = standardized mean difference (SMD) not estimable.
† 1 = high; 0 = low.
‡ Calculation of standardized mean difference (Hedges' g) based on , *P* F, or t-value, a positive SMD (a SMD with a 0.95 Ci indicates a decrease in pain and an increase in functional ability; if more than two groups were evaluated, the two groups with the greatest contrast in intervention were compared.
For further information about the methodologic quality see Table 1.

All but one of the 8 studies (47) measured one or more process measures. Of the 7 studies (19,24,40,45,46,48) that assessed knowledge, 2 RCTs/CCTs (24,40) demonstrated a significant increase in knowledge after patients received instruction on joint protection. All ODs with sufficient methodologic quality (45,46,48) supported these findings. Thus, on the basis of the results of one high quality RCT (40), there is limited evidence that instruction on joint protection leads to an improvement of functional ability (Table 5).

Assistive devices. One CCT (61) and one OD (51) were included for the intervention "advice/instruction in the use of assistive devices" (Table 3). Only the latter study had sufficient methodologic quality.

Table 5. Outcome of best evidence synthesis and sensitivity analyses per intervention.

	Best evidence synthesis	Sensitivity analysis 1	Sensitivity analysis 2	Sensitivity analysis 3
Comprehensive occupational therapy	Limited evidence on functional ability	Limited evidence on functional ability	Indicative findings for effectiveness on functional ability	Limited evidence on functional ability
Training of motor function	No evidence	No evidence	No evidence	No evidence
Instruction on joint protection	Limited evidence on functional ability	Limited evidence on functional ability	Limited evidence on functional ability	Limited evidence on functional ability
Advice/instruction in the use of assistive devices	No evidence	No evidence	No evidence	No evidence
Provision of splints	Indicative findings for effectiveness on pain	Indicative findings for effectiveness only for the immediately assessed pain after provision of the splint	Indicative findings for effectiveness on pain	Indicative findings for effectiveness on pain

The results on outcome measures are shown in Table 4. Nordenskiöld (51) reported a significant decrease in pain when assistive devices were used while performing kitchen tasks. Thus, there is insufficient data to determine the effectiveness of advice/instruction in the use of assistive devices (Table 5).

Splints. Sixteen studies (Table 3) focused on the intervention "provision of splints." Seven of these studies were RCTs/CCTs (21,43,44,62–65), and 9 were ODs (49,50,52, 53,66–70). Within these 16 studies, six different types of splints were evaluated (working splint, resting splint, three types of antideformity splints, air-pressure splint). In 4 of the RCTs/CCTs (21,43,44,64), 2 splints were compared with each other. Three of the RCTs/CCTs (62,63,65) compared patients receiving splint treatment with a nontreated control group. Two of the RCTs (43,44) had high methodologic quality and 4 of the ODs (49,50,52,53) had sufficient methodologic quality.

The results on outcome measures are shown in Table 4. Pain was assessed with regard to two aspects. The effect on pain immediately after provision of the splint was evaluated in three studies (50,52,53). Nordenskiöld (50) and Pagnotta et al (52) reported a significant decrease in pain when patients wore working splints. The effect on pain after splinting for a period of 1 week to 1.5 year was assessed in ten studies (21,43,44,49,63,64,67–70). Only the 2 studies that compared splinting with no treatment (49,63) presented positive significant results.

Five studies (21,43,52,53,70) assessed measures of functional ability (dexterity). In one of these studies, a low quality RCT (21), a significant decline in dexterity after 1 week of wearing a working splint was reported.

Fifteen studies measured one or more process measures. Compliance with splinting was assessed by 5 studies (63,64,66,67,70), all of which had a low methodological quality. In one RCT (64), positive significant results on compliance were reported.

Grip strength was assessed with regard to 2 aspects. The effect on grip strength immediately after provision of the splint was evaluated in 6 studies (21,43,44,50,53,62). In two high quality studies (50,53) it was reported that patients had an increase in grip strength while wearing a splint. The effect of splinting on grip strength after a period of time was measured in four RCTs/CCTs (21,43,44,63). The 2 high quality RCTs (43,44) found no significant differences between groups. Four studies (43,44,65,67) measured range of motion, and in the 2 high quality RCTs (43,44), no significant differences between groups was reported. One low quality RCT (65) demonstrated significant improvement after patients wore an anti-boutonniere splint for 6 weeks.

Thus, there are indicative findings that splints are effective in reducing pain both immediately after provision of the splint and after splinting over a period of time (Table 5). Also, there are indicative findings that splinting has a negative effect on dexterity (Table 5). Furthermore, indicative findings for a gain in grip strength immediately after provision of the splint have been reported.

Training of skills, counseling. No studies concerning the interventions "training of skills" and "counseling" were identified.

Sensitivity analyses. Three sensitivity analyses were performed to determine the robustness of the outcome of the best evidence syntheses (Table 5).

Considering only studies that scored a high or sufficient methodologic quality, the outcome of the best evidence syntheses for all interventions (except provision of splints) is the same as the results presented. Within the category "provision of splints," only the indicative findings for evidence of splinting on the immediate decrease in pain will hold.

Analyzing the results with incorporation of studies with a score of 4 items or more on the internal validity criteria, the outcome of the best evidence synthesis is, for all interventions except "comprehensive OT," the same as the results presented. Within the category "comprehensive OT," the results of three studies (14,41,54) instead of one contribute to the best evidence synthesis. Two studies (14,54) found no significant results on functional abilities, whereas one (41) did. As a result, the findings of "limited evidence" changes to "indicative findings" for the evidence of effectiveness of OT on functional ability.

In 19 studies (14,19,21,40–42,47–50,52,55,63,64,67–70), investigators explicitly reported use of the ACR criteria for diagnosis of RA as inclusion criteria for the patients. Considering only those studies in the analysis, results are the same as the best evidence synthesis for all the interventions categories.

Discussion

In this review, the efficacy of several OT interventions for rheumatoid arthritis was explored. Seven different intervention categories were distinguished (comprehensive OT, training of motor function, training of skills, instruction on joint protection, counseling, advice/instruction in the use of assistive devices, and provision of splints). The outcome measures were pain, fatigue, functional ability, and social participation. Process measures such as knowledge about disease management, compliance, self-efficacy, grip strength, and range of motion were also taken into account. This systematic review established limited evidence for the effectiveness of 2 intervention categories on functional ability. Both comprehensive OT and instruction on joint protection resulted in an increase in functional ability. For the intervention "provision of splints," indicative findings for a decrease in pain were demonstrated. Indicative findings for a negative effect of splinting on dexterity were discovered, as were indicative findings for evidence that grip strength increases after provision of splints.

Randomized controlled trials, controlled clinical trials, and studies with other designs were included in this review. Sixteen ODs were identified. A distinction was made between ODs with sufficient methodological quality and those that lacked sufficient methodological quality. Because of the weakness of the internal validity of ODs, those with sufficient methodologic quality could demonstrate "indicative findings" only in the best evidence synthesis. Incorporation of the outcomes of ODs resulted in indicative findings for a decrease in pain immediately after provision of a splint. Within the other intervention categories,

results of ODs did not contribute to the outcome of the best evidence synthesis, because RCTs and/or CCTs were available. However, in most categories of interventions, the results of ODs supported the findings of RCTs/CCTs. Therefore, in emerging fields of research such as occupational therapy, results of studies other than controlled trials may have some value in assessing the effectiveness of interventions when RCTs and CCTs are lacking.

Overall, the methodologic quality of the studies was rather poor. Only 5 of the 15 RCTs had a high methodologic quality. No CCTs with a high methodologic quality were identified, and only one-half of the 16 ODs were considered of sufficient methodologic quality. Bias was possible, because most studies did not include information on blinding of patients, blinding of care providers, and blinding of outcome assessors. Because blinding of patients and care providers is rather difficult in allied health interventions, the blinding of the outcome assessor is of paramount importance to avert detection bias (71,72).

The nature of the OT interventions varied widely. Even within intervention categories, large differences in interventions with regard to type of treatment, duration, and setting precluded comparing results. Furthermore, poor data presentation impeded comparison of results among studies. Only five RCTs presented sufficient data to compute effect sizes. In future research, special attention should be given to the presentation of study results according to international standards (73). Finally, outcome measures were very heterogeneous. For each outcome and process measure, several measurement instruments were used. To overcome this problem, international consensus about a core set of outcome measures for the outcome of occupational therapy for rheumatoid arthritis is needed. The first question to be addressed should be which outcomes are most important for OT. The second question concerns which outcome instruments are most reliable, valid, responsive, and easy to obtain.

The power of the studies included in this review was rather poor. To detect a medium effect size of 0.5 (with $\alpha = 0.05$ and power at 80%), the sample size per group needs to be at least 50 (74). Only 2 controlled studies had a sample size of $\geq$50 participants per group (41,61). The findings of this review could be an underestimation of the real evidence for the effectiveness of OT, due to the limited power of the studies. Conversely, the results of this review could also be an overestimation because of publication bias by unpublished small negative studies.

In future research, several items about the efficacy of occupational therapy should be considered. To improve the methodologic quality of studies, proper randomization procedures should be performed after baseline assessment, with special attention to the concealment of allocation. Another important issue is the blinding of the outcome assessor. Because blinding of patients and care providers is almost impossible in OT interventions, procedures to guarantee the blinding of the outcome assessors are needed to prevent bias. Statistically significant differences are more likely to occur in studies with sufficient power. This means that large groups of rather homogenous participants should be included in trials that compare the experimental intervention with no treatment or, if that is not possible, with a treatment with a clear contrast. Furthermore, outcome measures should be carefully chosen with regard to the aim of the intervention. Studies in which outcome measures that are relevant and responsive are applied are more likely to result in statistically significant differences between groups.

The inventory of studies in this review reveals important gaps in OT research. No studies were found for the category "training of skills," and only two studies were found for the intervention "instruction/advice assistive devices." This is remarkable, because "training of skills" and "instruction/advice assistive devices" are very common OT interventions (3). Another finding is the lack of data on the outcome measure "social participation." The ultimate goal of OT is to restore/maintain full participation in all social activities. Outcome measures should reflect this aim.

In conclusion, we found limited evidence for the effectiveness of occupational therapy for functional ability and pain in patients with RA. Studies that evaluated comprehensive OT and those that evaluated instruction on joint protection interventions showed limited evidence for the effectiveness of these interventions on functional ability. Studies that evaluated splint interventions reported indicative findings for the effectiveness in reducing pain. These results are encouraging in terms of occupational therapy being an important part of treatment for patients with rheumatoid arthritis. Also, this review revealed that important fields of occupational therapy, such as "training of skills" and "advice in the use of assistive devices," are underresearched and should get more attention. On the basis of this review, we suggest that further clinical trials for each category of intervention are necessary. In future studies, special attention should be given to the design of trials, the use of responsive, reliable, and valid outcome measures, inclusion of a sufficient number of patients to create statistical power, and presentation of trial results according to international standards.

REFERENCES

1. Lindquist B, Unsworth C. Occupational therapy-reflections on the state of the art. WFOT-bulletin 1999;39:26–30.
2. Melvin JL. Rheumatic disease in the adult and child: occupational therapy and rehabilitation. Philadelphia: F.A. Davis; 1989.
3. Driessen MJ, Dekker J, Lankhorst GJ, Van der Zee J. Occupational therapy for patients with chronic diseases: CVA, rheumatoid arthritis and progressive diseases of the central nervous system. Disabil Rehabil 1997;19:198–204.
4. Clarke AK. Effectiveness of rehabilitation in arthritis. Clin Rehabil 1999;13:51–62.
5. Dickersin K, Scherer R, Lefebvre C. Identifying relevant studies for systematic reviews. BMJ 1994;309:1286–91.
6. Clarke M, Oxman AD, editors. Analysing and presenting results, Cochrane Reviewers Handbook 4.1. Oxford (England): The Cochrane Collaboration; 2000.
7. Van Tulder MW, Assendelft WJJ, Koes BW, Bouter LM. Method guidelines for systematic reviews in the Cochrane collaboration back review group for spinal disorders. Spine 1997;22:2323–30.
8. Jadad AR, Moore RA, Tugwell P. Assessing the quality of randomized controlled trials. Int J Technol Assess Health Care 1996;12:195–208.
9. Verhagen AP, Vet de HCW, Bie de RA, Kessels AGH, Boers M,

Bouter LM, et al. The delphi list: a criteria list for quality assessment of randomised clinical trials for conducting systematic reviews developed by delphi consensus. J Clin Epidemiol 1998;51:1235–41.
10. Wells GA, Shea B, O'Connell D, Peterson J, Welch V, Tugwell P. The Newcastle-Ottawa scale (NOS) for assessing the quality of non-randomised studies in meta-analyses. Third symposium on systematic reviews. www.lri.ca/programs/ceu/oxford.htm. Accessed August 10, 2002.
11. Rosenthal R. Parametric measures of effect sizes. In: Cooper H, Hedges LV, editors. The handbook of research synthesis. New York: Russell Sage Foundation; 1994. p. 231–44.
12. Van Tulder MW, Cherkin DC, Berman B, Lao L, Koes BW. Acupuncture for low back pain. In: The Cochrane Library. Oxford: Update Software; 2002.
13. Arnett FC, Edworthy SM, Bloch DA. The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis Rheum 1988;31:315–24.
14. Kraaimaat FW, Brons MR, Geenen R, Bijlsma JW. The effect of cognitive behavior therapy in patients with rheumatoid arthritis. Behav Res Ther 1995;33:487–95.
15. Huiskes CJAE, Kraaimaat FW, Brons MR, Bijlsma JW. Het effect van gedragstherapie en ergotherapie bij patienten met reumatoide artritis. Gedragstherapie 1991;24:253–68.
16. Van Deusen J, Harlowe D. The efficacy of the ROM Dance Program for adults with rheumatoid arthritis. Am J Occup Ther 1987;41:90–5.
17. Van Deusen J, Harlowe D. A comparison of the ROM Dance Home Exercise/Rest Program with traditional routines. Occup Ther J Res 1987;7:349–61.
18. Van Deusen J, Harlowe D. One-year follow-up results of ROM dance research. Occup Ther J Res 1988;8:52–4.
19. Furst GP, Gerber LH, Smith CC, Fisher S, Shulman B. A program for improving energy conservation behaviors in adults with rheumatoid arthritis. Am J Occup Ther 1987;41:102–11.
20. Gerber L, Furst G, Shulman B, Smith C, Thornton B, Liang M, et al. Patient education program to teach energy conservation behaviors to patients with rheumatoid arthritis: a pilot study. Arch Phys Med Rehabil 1987;68:442–5.
21. Stern EB, Ytterberg SR, Krug HE, Mahowald ML. Finger dexterity and hand function: effect of three commercial wrist extensor orthoses on patients with rheumatoid arthritis. Arthritis Care Res 1996;9:197–205.
22. Stern EB, Ytterberg SR, Krug HE, Mullin GT, Mahowald ML. Immediate and short-term effects of three commercial wrist extensor orthoses on grip strength and function in patients with rheumatoid arthritis. Arthritis Care Res 1996;9:42–50.
23. Stern EB, Ytterberg SR, Krug HE, Larson LM, Portoghese CP, Kratz WN, et al. Commercial wrist extensor orthoses: a descriptive study of use and preference in patients with rheumatoid arthritis. Arthritis Care Res 1997;10:27–35.
24. Neuberger GB, Smith KV, Black SO, Hassanein R. Promoting self-care in clients with arthritis. Arthritis Care Res 1993;6:141–8.
25. Alderson M, Starr L, Gow S, Moreland J. The program for rheumatic independent self-management: a pilot evaluation. Clin Rheumatol 1999;18:283–92.
26. Brattström M, Berglund K. Ambulant rehabilitation of patients with chronic rheumatic disease, a fourteen-month clinical trial: a preliminary report. Scand J Rehabil Med 1970;2:133–42.
27. Chen C, Strecker-Neufeld P, Feely CA, Sugg-Skinner C. Factors influencing compliance with home exercise programs among patients with upper-extremity impairment. Am J Occup Ther 1999;53:171–80.
28. Cytowicz K, Karpilowski W, Seyfried B. The influence of a joint orthosis on the grip force of the rheumatoid hand. Clin Rheumatol 1999;18:373–84.
29. Gault SJ, Spyker JM. Beneficial effect of immobilization of joints in rheumatoid and related arthritis: a splint study using sequential analysis. Arthritis Rheum 1969;12:34–43.
30. Karten I, Lee M, McEwen C. Rheumatoid arthritis: five-year study of rehabilitation. Arch Phys Med Rehabil 1973;54:120–8.
31. Kjeken I, Møller G, Kvien TK. Use of commercially produced elastic wrist orthoses in chronic arthritis: a controlled study. Arthritis Care Res 1995;8:108–13.
32. Löfkvist UB, Brattström M, Geborek P, Lidgren L. Individually adapted lightweight walking aids with moulded handles for patients with severely deforming chronic arthritis. Scand J Rheumatol 1988;17:167–73.
33. Maggs FM, Jubb RW, Kemm JR. Single-blind randomized controlled trial of an educational booklet for patients with chronic arthritis. Br J Rheumatol 1996;35:775–7.
34. Mann WC, Hurren D, Tomita M. Assistive devices used by home-based elderly persons with arthritis. Am J Occup Ther 1995;49:810–9.
35. Nicholas JJ, Gruen H, Weiner G, Crawshaw C, Taylor F. Splinting in rheumatoid arthritis: II. Evaluation of Lightcast fiberglass polymer splints. Arch Phys Med Rehabil 1982;63:95–6.
36. Schulte M, Meierjurgen R, Mattussek S. Patientenschulung bei chronischer polyartheritis. Präv Rehabil 1994;6:36–40.
37. Stern EB. Grip strength and finger dexterity across five styles of commercial wrist orthoses. Am J Occup Ther 1996;50:32–8.
38. Stern EB, Sines B, Teague TR. Commercial wrist extensor orthoses: hand function, comfort, and interference across five styles. J Hand Ther 1994;7:237–44.
39. Stewart D, Maas F. Splint suitability: a comparison of four wrist splints for arthritics. Aust Occup Ther J 1990;37:15–24.
40. Hammond A, Lincoln N, Sutcliffe L. A crossover trial evaluating an educational-behavioural joint protection programme for people with rheumatoid arthritis. Patient Educ Couns 1999;37:19–32.
41. Helewa A, Goldsmith CH, Lee P, Bombardier C, Hanes B, Smythe HA, et al. Effects of occupational therapy home service on patients with rheumatoid arthritis. Lancet 1991;337:1453–6.
42. Hoenig H, Groff G, Pratt K, Goldberg E, Franck W. A randomized controlled trial of home exercise on the rheumatoid hand. J Rheumatol 1993;20:785–9.
43. Ter Schegget MJ, Knipping AA. De zwanenhalsorthese bij reumatoide artritis. Ned Tijdsch Ergotherapie 1997;25:172–82.
44. Tijhuis GJ, Vlieland TPM, Zwinderman AH, Hazes JMW. A comparison of the Futuro wrist orthosis with a synthetic ThermoLyn orthosis: utility and clinical effectiveness. Arthritis Care Res 1998;11:217–22.
45. Barry MA, Purser J, Hazleman R, McLean A, Hazleman BL. Effect of energy conservation and joint protection education in rheumatoid arthritis. Br J Rheumatol 1994;33:1171–4.
46. Cartlidge PJ, Higson NB, Stent G. Rheumatoid arthritis: a pilot evaluation of an inpatient education programme. Aust Occup Ther J 1984;31:14–9.
47. Hammond A. Joint protection behavior in patients with rheumatoid arthritis following an education program: a pilot study. Arthritis Care Res 1994;7:5–9.
48. Hammond A, Lincoln N. The effect of a joint protection education programme for people with rheumatoid arthritis. Clin Rehabil 1999;13:392–400.
49. McKnight PT, Schomburg FL. Air pressure splint effects on hand symptoms of patients with rheumatoid arthritis. Arch Phys Med Rehabil 1982;63:560–4.
50. Nordenskiöld U. Elastic wrist orthoses: reduction of pain and increase in grip force for women with rheumatoid arthritis. Arthritis Care Res 1990;3:158–62.
51. Nordenskiöld U. Evaluation of assistive devices after a course in joint protection. Int J Technol Assess Health Care 1994;10:293–304.
52. Pagnotta A, Baron M, Korner-Bitensky N. The effect of a static wrist orthosis on hand function in individuals with rheumatoid arthritis. J Rheumatol 1998;25:879–85.
53. Rennie HJ. Evaluation of the effectiveness of a metacarpophalangeal ulnar deviation orthosis. J Hand Ther 1996;9:371–7.
54. Mowat AG, Nichols PJ, Hollings EM, Haworth RJ, Aitken LC.

A comparison of follow-up regimes in rheumatoid arthritis. Ann Rheum Dis 1980;39:12–7.
55. McAlphine CH, Woodhouse E, MacDonald J, Hunter J. Occupational therapy in elderly patients with rheumatoid arthritis. Clin Rehabil 1991;5:123–6.
56. Brighton SW, Lubbe JE, van der Merwe CA. The effect of a long-term exercise programme on the rheumatoid hand. Br J Rheumatol 1993;32:392–5.
57. Dellhag B, Wollersjö I, Bjelle A. Effect of active hand exercise and wax bath treatment in rheumatoid arthritis patients. Arthritis Care Res 1992;5:87–92.
58. Ring D, Simmons BP, Hayes M. Continuous passive motion following metacarpophalangeal joint arthroplasty. J Hand Surg (Am) 1998;23:505–11.
59. Waggoner CD, Lelieuvre RB. A method to increase compliance to exercise regimens in rheumatoid arthritis patients. J Behav Med 1981;4:191–201.
60. Schaufler J, Sverdlik SS, Baker A, Krewer SE. "Hand gym" for patients with arthritic hand disabilities: preliminary report. Arch Phys Med Rehabil 1978;59:221–6.
61. Hass U, Brodin H, Andersson A, Persson J. Assistive technology selection: a study of participation of users with rheumatoid arthritis. IEEE Trans Rehabil Eng 1997;5:263–75.
62. Anderson K, Maas F. Immediate effect of working splints on grip strength of arthritic patients. Aust Occup Ther J 1987;34: 26–31.
63. Callinan NJ, Mathiowetz V. Soft versus hard resting hand splints in rheumatoid arthritis: pain relief, preference, and compliance. Am J Occup Ther 1996;50:347–53.
64. Feinberg J. Effect of the arthritis health professional on compliance with use of resting hand splints by patients with rheumatoid arthritis. Arthritis Care Res 1992;5:17–23.
65. Palchik NS, Mitchell DM, Gilbert NL, Schulz AJ, Dedrick RF, Palella TD. Nonsurgical management of the boutonniere deformity. Arthritis Care Res 1990;3:227–32.
66. Agnew PJ, Maas F. Compliance in wearing wrist working splints in rheumatoid arthritis. Occup Ther J Res 1995;15: 165–80.
67. Feinberg J, Brandt KD. Use of resting splints by patients with rheumatoid arthritis. Am J Occup Ther 1981;35:173–8.
68. Malcus JP, Sandkvist G, Eberhardt K, Liang B, Herrlin K. The usefulness of nocturnal resting splints in the treatment of ulnar deviation of the rheumatoid hand. Clin Rheumatol 1992;11:72–5.
69. McKnight PT, Kwoh CK. Randomized, controlled trial of compression gloves in rheumatoid arthritis. Arthritis Care Res 1992;5:223–7.
70. Spoorenberg A, Boers M, van der Linden S. Wrist splints in rheumatoid arthritis: a question of belief? Clin Rheum 1994; 13:559–63.
71. Siemonsma PC, Walker MF. Practical guidelines for independent assessment in randomized controlled trials (RCTs) of rehabilitation. Clin Rehabil 1997;11:273–9.
72. Day SJ, Altman DG. Blinding in clinical trials and other studies. BMJ 2000;321:504.
73. Begg C, Cho M, Eastwood S, Horton R, Moher D, Olkin I, et al. Improving the quality of reporting of randomized clinical trials: the CONSORT statement. JAMA 1996;276:637–9.
74. Cohen J. Statistical power analysis for the behavioral sciences. 2th ed, Hillsdale (NJ): Lawrence Erlbaum Associates; 1988. p. 54.

Appendix 1. Criteria of Methodological Quality*

Randomized Clinical Trials, Controlled Clinical Trials
Patient selection
- a) Were the eligibility criteria specified?
- b) Treatment allocation:
  - 1) Was a method of randomization performed?
  - 2) Was the treatment allocation concealed?
- c) Were the groups similar at baseline regarding the most important prognostic indicators?

Interventions
- d) Were the index and control interventions explicitly described?
- e) Was the care provider blinded for the intervention?
- f) Were co-interventions avoided or comparable?
- g) Was the compliance acceptable in all groups?
- h) Was the patient blinded to the intervention?

Outcome measurement
- i) Was the outcome assessor blinded to the interventions?
- j) Were the outcome measures relevant?
- k) Were adverse effects described?
- l) Was the withdrawal/drop out rate described and acceptable?
- m) Timing followup measurements:
  - 1) Was a short-term followup measurement performed?
  - 2) Was a long-term followup measurement performed?
- n) Was the timing of the outcome assessment in both groups comparable?

Statistics
- o) Was the sample size for each group described?
- p) Did the analysis include an intent-to-treat analysis?
- q) Were point estimates and measures of variability presented for the primary outcome measures?

Other design
Patient selection
- a) Were the eligibility criteria specified?

Interventions
- d) Was the intervention explicitly described?
- f) Were cointerventions avoided?
- g) Was the compliance acceptable?

Outcome measurement
- i) Was the outcome assessor not involved in the treatment?
- j) Were the outcome measures relevant?
- k) Were adverse effects described?
- l) Was the withdrawal/drop out rate described and acceptable?
- m) Timing follow-up measurements:
  - 1) Was a short-term followup measurement performed?
  - 2) Was a long-term followup measurement performed?
- n) Was the timing of the outcome assessment in all patients comparable?

Statistics
- o) Was the sample size of the patient group described?
- p) Did the analysis include an intent-to-treat analysis?
- q) Were point estimates and measures of variability presented for the primary outcome measures?

* Internal validity = b, e, f, g, h, i, j, l, n, p; descriptive criteria = a, c, d, k, m; statistical criteria = o, q.

Supplement to Appendix 1. Specification of the criteria for methodological quality

a. In order to score a 'yes' explicit classification criteria for RA should be described. An established set of criteria (ARA classification) or clinical criteria including disease duration. The condition of interest (for example: pain when treatment is a resting splint) is described as present at the start of the study.
b1 A random (unpredictable) assignment sequence. Methods of allocation using date of birth, date of admission, hospital numbers, or alternation should not be regarded as appropriate.
b2 Assignment generated by an independent person not responsible for determining eligibility of the patients. This person has no information about the persons included in the trial and has no influence on the assignment sequence or the decision about eligibility of the patient.
c In order to receive a 'yes' groups have to be similar regarding four of the most important prognostic factors: age, duration of disease, severeness of disease, baseline main outcome measure(s). If a baseline difference exists in one of the these factors, a no applies.
d Adequate description of type, modality, application technique, intensity, duration, number of frequency of sessions for both the experimental interventions and (only for B4) control intervention(s) in order to replicate the study.
e The reviewer determines when enough information about the blinding is given in order to score a 'yes'. For Occupational therapy this item scores always 'no'.
f Co-interventions concerning other similar to occupational therapy interventions are avoided or either standardised.
g The reviewer determines when the compliance to the interventions is acceptable when based on the reported intensity, duration, number and frequency of sessions for the experimental intervention and (only B7) the control intervention(s). Criterion compliance >70% in all groups.
h The reviewer determines (per outcome parameter) when enough information about blinding is given to score a 'yes'. For occupational therapy this item always scores a 'no'.
i The reviewer determines (per outcome parameter) when enough information about independency/blinding is given to score a 'yes'.
j At least one of the important outcome parameters. For this review; pain, fatigue, functional abilities (including dexterity), physical independence and quality of life (including well being).
k Each event described and correctly attributed to (allocated) treatment; if explicit report of 'no adverse effect' a 'yes' applies. Scores either a 'yes' or a 'no', a don't know doesn't exist.
l Participants who were included in the study but did not complete the observation period or were not included in the analysis must be described. If the percentage of withdrawals and drop-outs does not exceed 20% for short-term follow-up and 30% for long-term follow-up and does not lead to substantial bias a 'yes' is scored. No drop-outs reported scores as don't know.
m1 Outcome assessment at the end of the intervention period.
m2 Outcome assessment ≥6 months after pre-test.
n Timing of outcome assessment identical for all patients (A10) or identical for all intervention groups (B14); for all important outcome assessments.
o To be presented per group at pre-test and for most important outcome assessments.
p All patients are reported/analysed for the most important moments of effect measurement (minus missing values) irrespective of non-compliance and co-interventions.
q Both point estimates and measures of variability should be presented (to be scored for each important outcome parameter separately). Point estimates are: means, medians, modes etc. Measures of variability are; standard deviations, 95% confidence intervals, etc. For dichotomous or categorical data proportions have to be presented.

Appendix 2. Characteristics of excluded studies*

Author (ref.)	Design and reason for exclusion
Alderson, et al (25)	Pre–post test, multidiscipline intervention
Brattström, et al (26)	Cohort study, participants with RA and other diseases, multi-discipline intervention
Chen, et al (27)	Patient series, participants with RA and other diseases
Cytowicz, et al (28)	Pre–post test, outcome measures not included in review
Gault, et al (29)	Pre–post test, outcome measures grip strength and range of motion only measured as adverse effects of immobilisation intervention
Karten, et al (30)	Patient series, multi-discipline intervention
Kjeken, et al (31)	RCT, participants with RA and other diseases
Löfkvist, et al (32)	Patient series, outcome measures not included in review
Maggs, et al (33)	RCT, participants with RA and other diseases
Mann, et al (34)	Cohort study, participants with RA and other diseases
Nicholas, et al (35)	Patient series, outcome measures not included in review
Schulte, et al (36)	Patient series, participants with RA and other diseases, multi-discipline intervention
Stern, et al (37)	CCT, participants in study are women with no physical disability
Stern, et al (38)	CCT, participants in study are women with no physical disability
Stewart, et al (39)	Cohort study, outcome measures not included in review

* RCT = randomized clinical trial; CCT = controlled clinical trial; RA = rheumatoid arthritis.